

# **ACCEPTANCE OF NANOTECHNOLOGY AMONG HALAL FOOD MANUFACTURER**

**SITI NORBILAH BINTI ABDUL MANAFF  
(808402)**

**UNIVERSITI UTARA MALAYSIA**

**2012**

# **ACCEPTANCE OF NANOTECHNOLOGY AMONG HALAL FOOD MANUFACTURER**

**The Project Paper Submitted to the College of Business in PARTIAL  
Fulfillment to the requirements for the Degree of Master of Science  
(Management)**

**Universiti Utara Malaysia**

**By**

**SITI NORBILAH BINTI ABDUL MANAFF**

## **PERMISSION TO USE**

---

In presenting this project paper in partial of requirement for a postgraduate degree from the Universiti Utara Malaysia(UUM), the author agrees that the University Library may make it freely available for inspection. The author further agree that permission for copying of this thesis in any manner in whole or in part, for scholarly purposes may be granted by my supervisor on in their absence by the Dean of the Graduate School. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without any written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia (UUM) for any scholarly use which may be made of any material from thesis. Requests for permission to copy or to make other use of materials in this thesis, in whole or in part should be addressed for:

Assistant Vice-Chancellor

College of Business

Universiti Utara Malaysia

06010 Sintok

Kedah Darul Aman

## ABSTRACT

---

In today's competitive market technology, it is essential to keep leadership in the food and food processing industry. Consumers demand fresh authentic, convenient and flavourful food products. The future belongs to new products and new processes, with the goal of enhancing the performance of the product, prolonging the product shelf life and freshness, and improving the safety and quality of food. Nanotechnology is an enabling technology that has the potential to revolutionise the food industry. The objective of this research is to identify the factors that contribute to the readiness of the halal food company to participate in nanotechnology. Based on the theoretical framework, the independent variables are benefits, complexity, compatibility and environment and the dependent variable is the Nanotechnology in Halal Food Readiness. The data was gathered from the questionnaire session and also from journals, books, newspaper, articles and also through internet. The data collected were analyzed using SPSS. As a result, the independent variable Complexity and Environment influences the Nanotechnology in Halal Food Readiness and the benefit and compatibility are not supported the nanotechnology in halal food readiness. For the conclusion, the halal food company should gain more knowledge about new technologies called nanotechnologies for the better result on producing the halal food.

## ABSTRAK

---

Dalam teknologi pasaran yang kompetitif hari ini, ia adalah penting untuk mengekalkan kepimpinan dalam industri pemprosesan makanan dan minuman. Pengguna menuntut produk makanan segar yang sah, mudah dan berperisa. Masa depan kepunyaan produk baru dan proses baru, dengan matlamat meningkatkan prestasi produk, memanjangkan hayat produk dan kesegaran dan meningkatkan keselamatan dan kualiti makanan. Nanoteknologi merupakan teknologi yang membolehkan yang mempunyai potensi untuk merevolusikan industri makanan. Objektif kajian ini adalah untuk mengenalpasti mengenalpasti faktor-faktor yang menyumbang kepada kesediaan syarikat makanan halal untuk mengambil bahagian dalam nanoteknologi. Berdasarkan rangka kerja teori, pembolehubah bebas adalah faedah, kerumitan, keserasian dan alam sekitar dan pembolehubah bersandar ialah kesediaan Nanoteknologi dalam penyediaan Makanan Halal. Data yang telah berkumpul dari sesi soal selidik dan juga daripada jurnal, buku, akhbar, artikel dan juga melalui internet. Data yang dikumpul dianalisis dengan menggunakan SPSS. Hasilnya, pembolehubah Kerumitan dan Alam Sekitar mempengaruhi kesediaan Nanoteknologi dalam penyediaan Makanan Halal dan manfaat dan keserasian tidak menyokong kesediaan Nanoteknologi dalam penyediaan Makanan Halal. Kesimpulan, syarikat makanan halal perlu mendapatkan pengetahuan yang lebih lanjut mengenai teknologi baru yang dipanggil Nanoteknologi untuk melibatkan diri dalam menghasilkan makanan halal menggunakan Nanoteknologi.

## ACKNOWLEDGEMENT

---

Needless to say, an undertaking such as the preparation of this thesis would not have been possible without the assistance and guidance of many individuals and organisations. Nevertheless, I would hereby like to express thanks to the following people for their valuable guidance, co-operation and encouragement during the course of my thesis work:

Firstly, I want to express my appreciation to Dr. Amlus Ibrahim, my supervisor and also as a thesis coordinator for providing me with a guideline regarding all aspect in this research field, and also for the guidance, suggestion, and lessons during research period. My appreciation also goes to my husband Nafizulshah Ismail, my parents Abdul Manaff Hassan and Asma Mat, for their support and guidance my kids Siti Sarah, Siti Aisyah and Siti Hawa and tries their best to advice and helps me during my research.

Thank you also given to my senior, Mardiatul Akmal and Noornasirah Nasri for share some of the experience on preparing the thesis format and give me a guideline on how to approach and deal with busy people. Not forget also, my best friend Nurhidayah Haji Mat Zaini which always with me to complete the research and also contribute some help and information for me during research suggestion and comment on my research, thank you very much.

University Utara Malaysia, June, 2012

Siti Norbilah Binti Abdul Manaff

(808402)

# TABLE OF CONTENTS

---

CONTENT	PAGE
TITTLE PAGE	i
PERMISSION TO USE	ii
ABSTRACT	iii
ABSTRAK	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xi
LIST OF FIGURES	xii

## CHAPTER 1: INTRODUCTION

1.0	Chapter Introduction	1
1.1	Background of the study	1
1.2	Problem Statement	8
1.3	Research question	9
1.4	Research objective	9
1.5	Significance of the study	10
1.6	Scope of research	10
1.7	Limitations of the research	11
1.8	Summary of the chapter	11

## **CHAPTER 2: LITERATURE REVIEW**

2.0	Chapter Introduction	12
2.1	History of Nanotechnology	12
2.2	What is nanotechnology?	14
2.3	Nanotechnology in the Food Market	15
2.4	Benefits	18
2.5	Complexity	20
2.6	Compatibility	22
2.7	Environmental	23
2.8	Nanotechnology in Halal food readiness	26
2.8.1	Contamination Sensor	28
2.8.2	Antimicrobial Packaging	29
2.8.3	Improved Food Storage	29
2.8.4	Enhanced Nutrient Delivery	29
2.8.5	Texture	30
2.8.6	Flavour	30
2.9	Previous Research	31
2.10	Pilot Survey	33
2.11	Theoretical Framework	35
2.12	List of Research Hypotheses	36
2.13	Summary of the chapter	37



## **CHAPTER 3: RESEARCH METHODOLOGY**

3.0	Chapter Introduction	38
3.1	Research Design	38
3.1.1	Type of Research	39
3.1.2	Type of Study	40
3.1.3	Time Dimension	40
3.1.4	Research Environment or Study	40
3.2	Research Variable	40
3.3	Types of Analysis	41
3.3.1	Statistical Analysis	41
3.3.2	Analysis Tools	42
3.4	Summary of the Chapter	43

## **CHAPTER 4: RESEARCH FINDINGS**

4.0	Chapter Introduction	44
4.1	Data Collection Approaches	44
4.2	Sampling Design	44
4.2.1	Population and Sample	45
4.2.2	Sample Selection Procedure	45
4.2.3	Sample Size	45
4.3	Research Instruments	46
4.4	Data Analysis Summary	46

4.5	Descriptive Statistics of Data Collection	47
4.5.1	Age of respondents	47
4.5.2	Gender of respondents	48
4.5.3	Position of the respondents	48
4.6	Mean and Standard Deviation	49
4.6.1	Benefit	50
4.6.2	Complexity	51
4.6.3	Compatibility	52
4.6.4	Environment	53
4.6.5	Nanotechnology readiness	53
4.7	Reliability Analysis	54
4.8	Descriptive Statistics	56
4.9	Restatement of Hypothesis	56
4.10	Multiple Regression Analysis	57
4.11	Summary of the chapter	59

## **CHAPTER 5: CONCLUSION AND RECOMMENDATION**

5.0	Chapter Introduction	61
5.1	Discussion	61
5.2	Conclusion	62
5.3	Implication of the research	64
5.4	Recommendation	65

## **REFERENCES**

## **APPENDIX A- QUESTIONNAIRE**

## **APPENDIX B- FREQUENCY ANALYSIS**

## LIST OF TABLES

<b>Table 4.1</b>	<b>Age of respondents</b>	<b>48</b>
<b>Table 4.2</b>	<b>Gender of respondents</b>	<b>48</b>
<b>Table 4.3</b>	<b>Position of the respondents</b>	<b>49</b>
<b>Table 4.4</b>	<b>Means and Standard Deviation of Items measuring the benefit</b>	<b>50</b>
<b>Table 4.5</b>	<b>Means and Standard Deviation of Items measuring the complexity</b>	<b>51</b>
<b>Table 4.6</b>	<b>Means and Standard Deviation of Items measuring Compatibility</b>	<b>52</b>
<b>Table 4.7</b>	<b>Means and Standard Deviation of Items measuring the Environment</b>	<b>53</b>
<b>Table 4.8</b>	<b>Means and Standard Deviation of Items measuring the nanotechnology in halal food readiness.</b>	<b>54</b>
<b>Table 4.9</b>	<b>Reliability Statistic for all variables</b>	<b>55</b>
<b>Table 4.10</b>	<b>Reliability Statistic for each variable</b>	<b>55</b>
<b>Table 4.11</b>	<b>Mean and Standard Deviation for Independence Variables</b>	
	<b>Descriptive Statistics</b>	<b>50</b>
<b>Table 4.12</b>	<b>Model Summary</b>	<b>57</b>
<b>Table 4.13</b>	<b>ANOVA</b>	<b>58</b>
<b>Table 4.14</b>	<b>Coefficient</b>	<b>58</b>
<b>Table 5.1</b>	<b>A Summary of result of Hypothesis Testing</b>	<b>63</b>

## **LIST OF FIGURES**

---

<b>Figure 1.1</b>	<b>Sample for nanofood applications</b>	<b>3</b>
<b>Figure 2.1</b>	<b>Nanoscale of atom.</b>	<b>14</b>
<b>Figure 2.2</b>	<b>World Nanofood Market</b>	<b>16</b>
<b>Figure 2.3</b>	<b>Theoretical Framework</b>	<b>35</b>
<b>Figure 4.1</b>	<b>Normal P-P Plot on Frequency of Nanotechnology in Halal Food Readiness</b>	<b>62</b>

# CHAPTER 1: INTRODUCTION

---

## 1.0 Chapter Introduction

This chapter introduces the topic of the research. Among others, it discusses the background of the study and the purpose of carrying out the research. Besides that, the chapter also clarifies its limitation.

## 1.1 Background of the study.

In today's competitive market technology, it is essential to keep leadership in the food and food processing industry. Consumers demand fresh authentic, convenient and flavourful food products. The future belongs to new products and new processes, with the goal of enhancing the performance of the product, prolonging the product shelf life and freshness, and improving the safety and quality of food. "Is it halal?" This question is being asked by a steadily growing group of conscious Muslim consumers, and they require a clear answer. Recognised as a modern Muslim nation, Malaysia is well positioned to be an international halal food hub in the branding, processing and marketing of halal foods to Muslim populations. This growing global market is estimated at RM 560 billion (USD 150 billion) per year. The Department of Islamic Development Malaysia (JAKIM) certifies all "halal" food products (Malaysian Industrial Development Authority, 2005). This scenario shows that Malaysia has a potential to market the halal product worldwide. Nowadays, many of Food Company have a halal certification, in order for people to make sure that their food are halal and safe to eat without any doubt. Much effort has been done by

The contents of  
the thesis is for  
internal user  
only

## REFERENCES

---

- Ashwood P, Thompson R and J Powell (2007); *Fine particles that adsorb lipopoly saccharide viabridging calcium cations may mimic bacterial pathogenicity towards cells*. Exp Biol Med 2007;232(1):107-117.
- Anthony Waitz and Wasig Bothare: *Nanotechnology Commercialization Best Practices*.  
<http://www.quantronainsight.com/pper/030915.commercialization.pdf>
- Andrew Maynard, Evan Michelson (2005, 2006, 2007), “*Projects on Emerging Technologies*,” Woodrow Wilson International Center for Scholars, A Nanotechnology consumer Products Inventory  
(<http://www.nanotechproject.org/44>).
- Automation: the latest innovations in robotics The ongoing debate over labelling legislation Halal foods: a growing industry*; Volume 34 Issue 2 April/May 2009: <http://www.fei-online.com> & search 10525
- Bowman D and G Hodge A Small Matter of Regulation (2007): *An International Review of Nanotechnology Regulation*. Columbia Sci Technol Law Rev; 8:1-32.
- Barriers to Nanotechnology Commercialization (2007). Report prepared for U.S. Department of Commerce, Technology Administration September 2007.
- Brody, A.L. 2006a. *Nano and food packaging technologies converge*. Food Technol. 60(3): 92-94.
- Brody, A.L. 2006b. *Food packaging climbs to the summit*. Food Technol. 60(7): 73-75.
- BASF. Solu™ E 200 BG( August 2005) : Water soluble Vitamin E compound \*. *Products for the Dietary Supplement, Beverage and Food Industries--* Technical Information. Available at: [http://www.basf.cl/quimicafina/nutricionhumana/fichastecnicas/vitaminas/liposolubles/solu\\_e200\\_bg.pdf](http://www.basf.cl/quimicafina/nutricionhumana/fichastecnicas/vitaminas/liposolubles/solu_e200_bg.pdf).
- Cientifica, 2006. Homepage. Available at: [http://www.cientifica.eu/index.php?page=shop\\_browse&category\\_id=2&option=com\\_virtuemart&Itemid=80](http://www.cientifica.eu/index.php?page=shop_browse&category_id=2&option=com_virtuemart&Itemid=80) (accessed 15 December 2011).



College of Nanoscale Science and Engineering Facilities,  
<http://cnse.albany.edu/facilities>

Consumer Talk Nano, *The Nanotechnology Consumer Products Inventory*  
[www.nanotechproject.org/consumerproducts](http://www.nanotechproject.org/consumerproducts).

Carl Marziali, "Little Big Science," USC Trojan Family Magazine, Winter 2007.

*Characterising the Potential Risks Posed by Engineered Nanoparticles: A First UK Government Research Report*. London : Department for Environment, Food and Rural Affairs, Nanotechnology Research Co-ordination Group Secretariat, 2005. (Available online at <http://www.defra.gov.uk/environment/nanotech/nrcg/pdf/nanoparticles-riskreport.pdf>).

Dunford R, Salinaro A, Cai L, Serpone N, Horikoshi S, Hidaka H, Knowland J. (1997). *Chemical oxidation and DNA damage catalysed by inorganic sun screen ingredients*. FEBS Lett 418:87-90.

Daniells S (2007). *Thing big, think nano*. Food Navigator.com Europe 19 December 2007. Available at: <http://www.foodnavigator.com/news/ng.asp?n=82109>.

Gainesville, FL : University of Florida, 2004. *Developing Experimental Approaches for the Evaluation of Toxicological Interactions of Nanoscale Materials : Final Report*. (Available online at <http://www.nanotoxicology.ufl.edu/workshop/images/NanoToxWorkshop.pdf>).

Educating Small Tech's Revolutionaries, Small times, Vol. 7, No 3, and May/June 2007. [www.smalltimes.com](http://www.smalltimes.com)

Fritz Allhoff, Patrick Lin, James Moor, and John Weckert (2007) *"Nanoethics: The Ethical and Societal Implications of Nanotechnology"*. Hoboken: John Wiley & Sons. <http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470084170.html>. "Wiley". <http://www.nanoethics.org/wiley.html>.

FoodQualityNews.com. (2005). *CNI ushers in future with 30 nanotech patents*. Available at: <http://www.foodqualitynews.com/news/ng.asp?id=58288-cniushers>- in (accessed 26 November 2011).

FoodProductionDaily.com (2006a). *Biosensor uses nanotechnology to spot the right smell*. FoodProductionDaily.com. Available at: <http://www.foodproductiondaily.com/news/ng.asp?id=67830> .

Fleischwirtschaft (2006). Available at: [http://www.aquanova.de/media/pulic/publikationen2006/Fleischwirtschaft\\_ProfWeber\\_](http://www.aquanova.de/media/pulic/publikationen2006/Fleischwirtschaft_ProfWeber_)

NovaSOL\_060502.pdf (accessed 24 December 2011).

*Food Technology Magazine*, November 2006. (<http://www.ift.org/Knowledge-Center/Read-IFT-Publications/Science-Reports/Scientific-Status-Summaries/Editorial/Food-Nanotechnology.aspx>).

Gavelin K, Wilson R and R (2007); *Doubleday Democratic technologies? The final report of the Nanotechnology Engagement Group*. Involve, London.. Available at: <http://83.223.102.125/> (accessed 8 Jun 2012).

Graduate Bulletin, College of Nanoscale Science and Engineering,  
[http://www.albany.edu/grad/school\\_nanoscience\\_nanoengineering.html](http://www.albany.edu/grad/school_nanoscience_nanoengineering.html)

Helmut Kaiser Consultancy Group. (2007a). *Nanopackaging Is Intelligent, Smart And Safe Life*. New World Study By Hkc22.com/beijingOffice. Press Release 14.05.07 Available at <http://www.prlog.org/10016688-nanopackaging-isintelligent-smart-and-safe-life-newworld-study-by-hkc22-com-beijing-office.pdf>.

Helmut Kaiser Consultancy Group. (2007b). *Strong increase in nanofood and molecular food markets in 2007 worldwide*. Available at: <http://www.hkc22.com/Nanofoodconference.html>.

Hagens W, Oomen A, de Jong W, Cassee F, Sips A. (2007). *What do we (need to) know about the kinetic properties of nanoparticles in the body?* Regul Toxicol Phamacol 49(3):217-229.

International Conference On Nanotechnology-Research And Commercialisation (Icont 2011); 9 June 2011.

*Implications of Nanotechnology for Environmental Health Research*. Institute of the Medicine, Washington, DC: National Academies Press.(Available online at <http://www.iom.edu/CMS/3793/4897/26111.aspx>).

Joseph T and M Morrison (2006). *Nanotechnology in Agriculture and Food*. Nanoforum Report.2006; Available at: <http://www.nanoforum.org/dateien/temp/nanotechnology%20in%20agriculture%20and%20food.pdf?08122006200524>.

Jumana Boussey, Georges Kamarinos, Laurent Montès (editors) (2003), *Towards Nanotechnology, "Nano et Micro Technologies"*, Hermes Sciences Publ., Paris, ISBN 2-7462-0858-X.

J. Clarence Davies (2007), *EPA and Nanotechnology: Oversight for the 21st Century, Project on Emerging Nanotechnologies*, PEN 9, May 2007.

- Knol, W.H.C(2004). “*Micro and Nanotechnology Commercialization: Balance Between Exploration and Exploitation*. “Proceedings of the MANCEF COM2004; Conference, Edmonton, Canada, 2004, pp.215-220.
- Mozafari M, Flanagan J, Matia L ,Merino M, Awati A, Omri A, Suntres Z and H Singh (2006); *Recent trends in the lipid-based nanoencapsulation of anti oxidants and their role in foods*. J Sci Food Ag 2006; 86:2038-2045.
- Michael Fancher(2004), “*A successful New Paradigm for Innovation and Education*,” Testimony to the Research Subcommittee of the Committee on Science of United House of Representative, 2004.
- Michael Darby, and Lynne Zucker (2003): Grilichesian Breakth Troughs, *Inventions of methods of Inventing and firm entry in Nanotechnology*, National Bureau of Economic Research, July 2003
- Maynard A. (2006). *Nanotechnology: Assessing the risks*. Nanotoday 1(2):22-33
- N. Islam\*, K. Miyazaki, (2009), "*Nanotechnology Innovation System: Understanding Hidden Dynamics of Nanoscience Fusion Trajectories*", Technological Social Change, Vol. 76, pp.128-140. ISSN: 0040-1625 (ABS Journal Ranking 3\*, Impact Factor 2.03)
- Nanotechnology and your view. Available at :  
<http://www.cam.ac.uk/research/news/nanotechnology-and-your-views/> (accessed 13 March 2012).
- Nu Mega Personal communication with company representative November 2007.
- Nanotechnology: *The Future is Coming Sooner Than You Think*; A JOINT ECONOMIC COMMITTEE STUDY; Jim Saxton (R-NJ), Ranking Member; United States Congress; March 2007.
- Nanobiotechnology: *Responsible Action on Issues in Society and Ethics*:  
<http://nanobio-raise.org/>
- NanoroadSME, “*Nanomaterial roadmap 2015; Roadmap report concerning the use of nanomaterials in the medical & health sector*”, NanoroadSME, 2006, [www.nanoroad.net](http://www.nanoroad.net) > downloads
- Nanotechnology and food; NanoBio-RAISE Co-ordination; [www.nanobio-raise.org](http://www.nanobio-raise.org)
- Nanosystem: Molecular Machinery, Manufacturing and Computation  
(<http://www.e-drexler.com/d/06/00/nanosystemterms.toc.html>, 2006 ISBN0-471-57518-6

"*Out of the Laboratory and to our plates*", Nanotechnology in Food & Agriculture, Friends of the Earth Australia, Friends of the Earth Europe and Friends of the Earth United States and supported by Friends of the Earth Germany; March 2008.

Powell J, Harvey R, Ashwood P, Wolstencroft R, Gershwin M and R Thompson (2000); *Immune potentiation of ultrafine dietary particles in normal subjects and patients with inflammatory bowel disease*. J Autoimmun 2000;14:99-105.

Renton A *Welcome to the world of nanofoods*. Guardian Unlimited UK 13 December 2006. Available at: <http://observer.guardian.co.uk/foodmonthly/futureoffood/story/0,,1971266,00.html> (accessed 17 January 2012).

Reynolds G (2007) FDA recommends nanotechnology research, but not labeling. FoodProductionDaily.com News 26 July 2007. Available at <http://www.foodproductiondaily-usa.com/news/ng.asp?n=78574-woodrowwilsonnanotechnologyhazardous> (accessed 24 January 2012).

Scenta (2007). High tech, non-stick nano packing. Available at: <http://www.scenta.co.uk/Health/1704070/hi-tech-non-stick-nano-packing.htm> (accessed 24 December 2011).

Sayer C, Wahi R, Kurian P, Liu Y, West J, Ausman K, Warheit D, Colvin V. 2006. *Correlating nanoscale titania structure with toxicity: A cytotoxicity and inflammatory response study with human dermal fibroblasts and human lung epithelial cells*. Toxicol Sci 92(1):174–185.

Shelke K (2008); *Hidden ingredients take cover in a capsule*. <http://www.foodprocessing.com/articles/2005/421.html> (accessed 17 January 2008).

Shefer A and S Shefer (2003a); *Biodegradable bioadhesive controlled release system of nano-particles for food products*, U.S. patent 2003a;6565873B1.

Shefer A and S Shefer (2003b); *Multi component biodegradable bioadhesive controlled release system for food products*. U.S. patent 2003b; 6: 589,562B1.

Shefer A and S Shefer (2003c); *Multi component controlled release system for oral care, food products, nano beverages*. U.S. patent application 2003c; 20030152629 A1.

T. Pradeep (2008), *Nano: The Essentials Understanding Nanoscience and Nanotechnology*, McGraw-Hill, New Delhi, April 2008.

The Silicon Valley Toxics Coalition (April, 2008), *Regulating Emerging Technologies in Silicon Valley and Beyond*

U.K.RS/RAE.(2004).*Nanoscience and nanotechnologies: opportunities and uncertainties*, Available at <http://www.nanotec.org.uk/finalReeport.htm>( accessed 17 January 2012).

William Sims Bainbridge (2007): *Nanoconvergence: The Unity of Nanoscience, Biotechnology, Information Technology and Cognitive Science*, June 27, 2007, Prentice Hall, ISBN 0-13-244643-X

Accessed 20 March 2012: <http://cnse.albany.edu>

Accessed 2 April 2012: <http://www.crnano.org/whatis.htm>

Accessed 15 April 2012:  
[http://www.businessweek.com/debateroom/archives/2009/03/nanofood\\_safe\\_and\\_green\\_cuisine.html](http://www.businessweek.com/debateroom/archives/2009/03/nanofood_safe_and_green_cuisine.html)

Accessed 15 April 2012:  
<http://observer.guardian.co.uk/foodmonthly/futureoffood/story/0%2C%2C1971266%2C00.html>

Accessed 15 April 2012: <http://www.foodprocessing-technology.com/features/feature46197/>

Accessed 15 April 2012: <http://www.epa.gov/nanoscience/basicinfo.htm>

Accessed 15 April 2012:  
<http://www.guardian.co.uk/science/2008/mar/26/nanotechnology.food>